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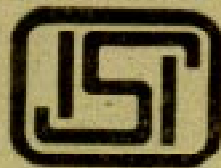
IS : 7304 ( Part III ) • 1973

## *Indian Standard*

# CODE FOR FABRICATION, INSTALLATION AND TESTING OF SALT WATER PIPING SYSTEM FOR SHIP BOARD USE

## PART III FERROUS SYSTEMS

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*Indian Standard*

# CODE FOR FABRICATION, INSTALLATION AND TESTING OF SALT WATER PIPING SYSTEM FOR SHIP BOARD USE

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## *Indian Standard*

# CODE FOR FABRICATION, INSTALLATION AND TESTING OF SALT WATER PIPING SYSTEM FOR SHIP BOARD USE

## PART III FERROUS SYSTEMS

### 0. FOREWORD

**0.1** This Indian Standard ( Part III ) was adopted by the Indian Standards Institution on 1 October 1973, after the draft finalized by the Shipbuilding Sectional Committee had been approved by the Marine, Cargo Movement and Packaging Division Council.

**0.2** This part of the standard covers the specific requirements for ferrous system of salt water piping system. General requirements of salt water piping system are covered in Part I and specific requirements for non-ferrous system are covered in Part II of this standard.

**0.3** This standard has been prepared to specify recommendations and requirements for salt water piping system in ships with the object of improving their service life.

**0.4** In preparing this standard full consideration has been given to the many factors involved, and to current practice regarding these, in the use of both ferrous and non-ferrous materials.

**0.5** Failure of the component parts of salt water piping systems may occur as a result of corrosion and erosion otherwise known as impingement attack arising from excessive turbulence. Such a condition may be brought about by poor design or workmanship or the use of too high a nominal water speed. Excessive water speed is a major factor and may arise as a result of poor design or misuse of the system. Failure may also occur by pitting resulting from deposit attack and cracking due to stress corrosion, or by general wastage in the case of ferrous systems.

**0.5.1** Attention should, therefore, be given to the design, fabrication and installation of systems to ensure streamlined flow. In particular, abrupt changes in the direction of flow, mismatched pipe bores, tube bore protrusions and other restrictions of flow should be avoided.

**0.6** At each stage of construction it is the responsibility of the fabricator to ensure compliance with the requirements of the statutory authorities as applicable.

**0.7** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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## 1. SCOPE

**1.1** This standard ( Part III ) specifies the requirements for the materials and fabrication of salt water piping system using ferrous components.

## 2. TERMINOLOGY

**2.1** For the purpose of this standard, the terms and definitions given in IS : 7304 ( Part I )† shall apply.

## 3. MATERIAL

**3.1** The material used for ferrous systems shall be in accordance with IS : 7304 ( Part I )‡.

## 4. FABRICATION

### 4.1 Pipes, Flanges, Bolting and Fittings

**4.1.1 Pipes** — The standard outside diameters and thicknesses of steel pipes are listed in Table 1. It should be noted that if the thicknesses given in the table do not meet the requirements of all classification societies or statutory authorities, the same are to be complied with as appropriate.

**4.1.2 Flanges and Bolting** — Dimensions shall be in accordance with appropriate tables of IS : 6392-1971‡, an extract from which is given in Table 1.

**4.1.3 Fittings** — Malleable steel pipes fittings in accordance with IS : 4310-1967§ and wrought steel pipe fittings in accordance with IS : 1239 ( Part II )-1963|| shall be used. Reference shall also be made to IS : 4693-1968¶.

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\*Rules for rounding off numerical values ( revised ).

†Code for fabrication, installation and testing of salt water piping system for ship board use: Part I General requirements. ( *Under preparation* )

‡Specification for steel pipe flanges.

§Specification for weldable steel pipe fittings for marine purposes.

||Specification for mild steel tubes, tubulars and other wrought steel fittings, Part II Mild steel tubulars and other wrought steel pipe fittings ( *second revision* ).

¶Specification for steel accessories for marine piping systems.



## 4.2 Manipulation and Fabrication of Steel Pipes

**4.2.1 Limits of Bending** — The minimum bending radii for pipes up to and including 450 mm nominal size shall be in accordance with Table 2.

**4.2.2 Cold Forming** — Bending machines or presses employed in forming bends cold shall be equipped with forming dies or rolls. Where internal mandrels are used these shall be fully hardened to avoid seizing and pick-up. Care shall be exercised during bending to avoid producing excessive scratching, grooving or die marks or contamination with non-ferrous material on the surface of the pipes. Water soluble extreme pressure lubricants as recommended by the manufacturer of the machine shall be used on mandrels or any surfaces where sliding friction occurs. Attention is drawn to 4.6 with regard to stress-relieving before galvanizing.

**4.2.3 Hot Forming** — The pipe shall be filled with dry silica sand, free from metallic contamination, specially non-ferrous contamination. Heating shall be carried out under slightly oxidizing conditions. The temperature of the pipe shall be raised to a maximum of 1 050°C and as much bending as possible shall be completed before the temperature of the pipe has fallen below 850°C. Bending may be continued below 850°C but all work on the pipe shall cease before the temperature has fallen to 750°C.

Where puckers have to be removed, use shall be made of a suitable shaped cress. Direct blows with a hammer are not permitted.

**4.2.4 Heat Treatment of Steel Pipes** — Where oxy-acetylene welding has been employed, all the pipes and branch pieces are recommended to be normalized on completion of welding as given below:

Hot finished seamless	} 880 to 920°C
Cold finished seamless	
Electric resistance welded	

After electric arc welding, all alloy steel pipes and branch pieces are recommended to be given a stress-relieving heat treatments. Suitable temperatures for stress-relieving carbon steel (other than shipbuilding quality steel) and alloy steel pipes and branch pieces are given below and recommended to be maintained for one hour per 25 mm of wall thickness:

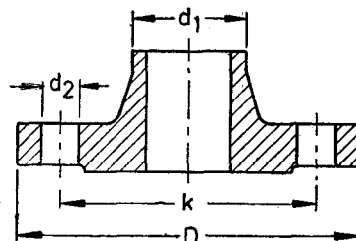
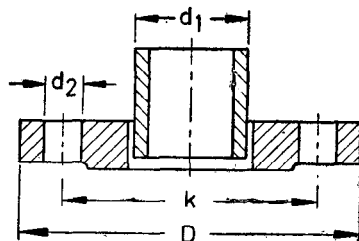
Carbon steel	580 to 620°C
Alloy steel	620 to 700°C

**4.2.5 Fabricated Bends** — Fabricated bends may be either of the segmental or cut-and-shut type as described in Fig. 1 and 2.

**TABLE 1 MATING DIMENSIONS FOR STEEL FLANGES FOR SHIPS' PIPELINES**

(Clauses 4.1.1 and 4.1.2)

All dimensions in millimetres.



STEEL TUBES			FLANGES											
Nom Size	Outside Diameter $d_1$	Thick-ness*	6 Bar				10 Bar				16 Bar			
			$D$	$K$	$d_2$	No. of Holes	$D$	$K$	$d_2$	No. of Holes	$D$	$K$	$d_2$	No. of Holes
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
6	10.2	2.6	For these nominal diameters and pressures, connection fittings are normally used											
8	12	2.9												
10	17.2	2.9												
15	(21.3)	3.2												
20	(26.9)	3.2												

25	( 33.7 )	4.0	100	75	11	4	115	85	14	4	115	85	14	4
32	( 42.4 )	4.0	120	90	14	4	140	100	18	4	140	100	18	4
40	48.3	4.0	130	100	14	4	150	110	18	4	150	110	18	4
50	60.3	4.5	140	110	14	4	165	125	18	4	165	125	18	4
65	76.1	4.5	160	130	14	4	185	145	18	4	185	145	18	4
80	88.9	5.0	190	150	18	4	200	160	18	8	200	160	18	8
100	114.3	5.4	210	170	18	4	220	180	18	8	220	180	18	8
125	139.7	5.4	240	200	18	8	250	210	18	8	250	210	18	8
150	168.3	5.4	265	225	18	8	285	240	22	8	285	240	22	8
175	193.7	5.4	—	—	—	—	315	270	22	8	315	270	22	8
200	219.1	6.3	320	280	18	8	340	295	22	8	340	295	22	12
250	273	6.3	375	335	18	12	395	350	22	12	405	355	26	12
300	323.9	7.1	440	395	22	12	445	400	22	12	460	410	26	12
350	355.6	8.0	490	445	22	12	505	460	22	16	520	470	26	16
400	406.4	8.0	540	495	22	16	565	515	26	16	580	525	30	16
450	457.2	8.0	595	550	22	16	615	565	26	20	640	585	30	20
500	508	8.0	645	600	22	20	670	620	26	20	715	650	33	20

\*For bends in pipes 150 mm nominal size and above, the use of thicker pipes may be required to avoid puckering during bending. Thicker pipes may also be required for hot bending pipes of below 150 mm nominal size requiring smaller bending radii.

TABLE 2 MINIMUM BENDING RADII FOR STEEL PIPES

( Clause 4.2.1 )

All dimensions in millimetres.

NOMINAL SIZE	OUTSIDE DIAMETER	RADIUS MEASURED TO CENTRE LINE OF PIPE
15	21.3	45
20	26.9	65
25	33.7	75
32	42.4	100
40	48.3	115
50	60.3	150
65	76.1	190
80	88.9	230
100	114.3	305
125	139.7	380
150	168.3	460
200	219.1	710
250	273.0	1 020
300	323.9	1 220
350	355.6	1 500
400	406.4	1 730
450	457.2	2 030

NOTE 1 — There is a practicable minimum thickness for each size below which larger radii should be used.

NOTE 2 — By agreement between the purchaser and the manufacturer smaller bending radii than those given in this table may be used provided that the necessary allowance is made in tube thickness. As an alternative in these cases it is recommended to use standard bends according to IS: 4310-1967 'Specification for weldable steel pipe fittings for marine purposes'.

### 4.3 Permanent Joining

**4.3.1 Welding** — The welding, preparation and jointing procedure for pipelines, pipe assemblies and flanges shall be in accordance with relevant Indian Standards.

In addition to the metal-arc process, the following welding processes may be used:

- TIG ( Inert gas tungsten arc ), and
- MIG ( Inert gas metal ) or CO<sub>2</sub>.

NOTE — Refractory tapes and ceramic coated backing system may be used subject to their removal after welding, where necessary to meet other requirements of this standard.

**4.3.1.1** The filler metal and electrodes to be adopted in the welding of pipelines by arc or gas welding shall be as given in Table 3.

**4.3.1.2** Resistance or other welding processes may be adopted subject to agreement between the purchaser and the manufacturer. The flash in the bore shall be removed in all instances on completion of the welding. It is anticipated that resistance welding will be most widely applied to the attaching of flanges to pipes but there is a lack of ship service experience in the use of these welds.

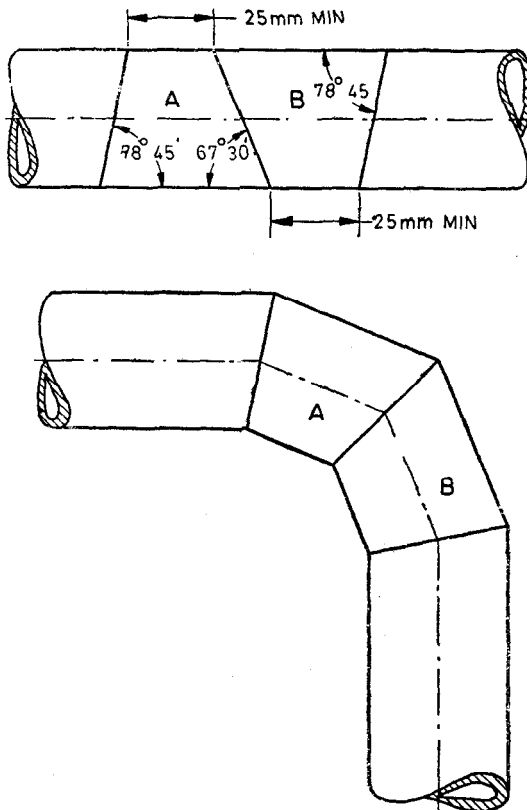
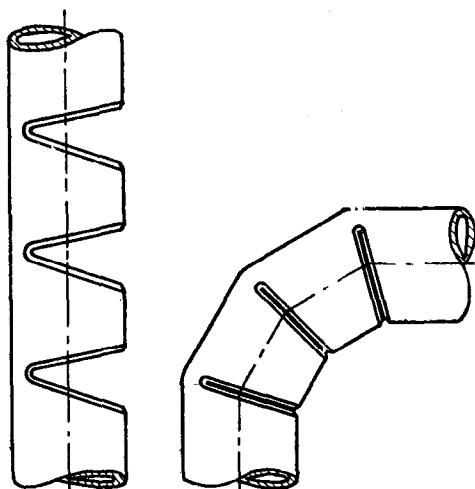


FIG. 1 SEGMENTAL ( GUSSETED ) BEND



VIEW AFTER BENDING AND WELDING

FIG. 2 CUT-AND-SHUT BEND

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**TABLE 3 FILLER METALS AND ELECTRODES FOR PIPELINE WELDING**  
 ( Clause 4.3.1.1 )

WELDING PROCESS	FILLER METALS AND ELECTRODES CONFORMING TO
Manual metal arc welding	IS : 814-1970*, IS : 1395-1971†
Oxy-acetylene welding	IS : 1278-1972‡
TIG, MIG or CO <sub>2</sub> welding	IS : 6419-1971§, IS : 6560-1972

NOTE — Low carbon steel fusible inserts may be used in conjunction with TIG process, by agreement between the purchaser and the manufacturer. Attention is drawn to the need to verify that the bore matching tolerances of the pipe ends are suitable in these cases.

\*Specification for covered electrodes for metal arc welding of structural steel ( *third revision* ).

†Specification for molybdenum and chromium-molybdenum-vanadium low alloy steel electrodes for metal arc welding ( *second revision* ).

‡Specification for filler rods and wires for gas welding ( *second revision* ).

§Specification for welding rods and bare electrodes for gas shielded arc welding of structural steel.

||Specification for molybdenum and chromium-molybdenum low alloy steel welding rods and base electrodes for gas shielded arc welding.

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**4.3.1.3** Where flanges are secured by screwing, the pipe and flange are to be screwed with a vanishing thread and the diameter of the screwed portion of the pipe over the thread is not to be appreciably less than the outside diameter of the unscrewed pipe. After the flange has been screwed bottom of the pipe is to be expanded into the flange.

**4.3.2 Brazing** — Brazing of steel pipes is not permitted.

**4.4 Bulkhead Pieces for Steel Pipes** — The approved designs are given in Fig. 3. All fabrication welds may be made in the shop, the attachment to the bulkhead being made by welding or bolting as required.

## 4.5 Weed Grids and Strainers

**4.5.1 Weed Grids** — Weed grids shall be fitted at the ship's shell at all sea water inlets to prevent large solids fouling the sea strainers. Preferably the grids shall be mounted with the bars running in a fore and aft direction. The grid bar spacings shall be minimum of about 25 mm with the ratio of clear grid area to area of sea inlet valve or valves not less than 2 : 1. No part of a grid shall stand proud of the hull. Grids shall be easily removed for dry dock inspection.

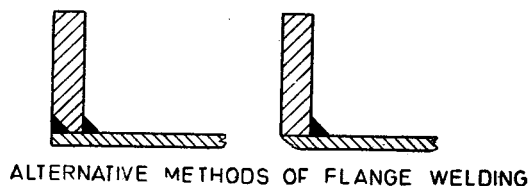
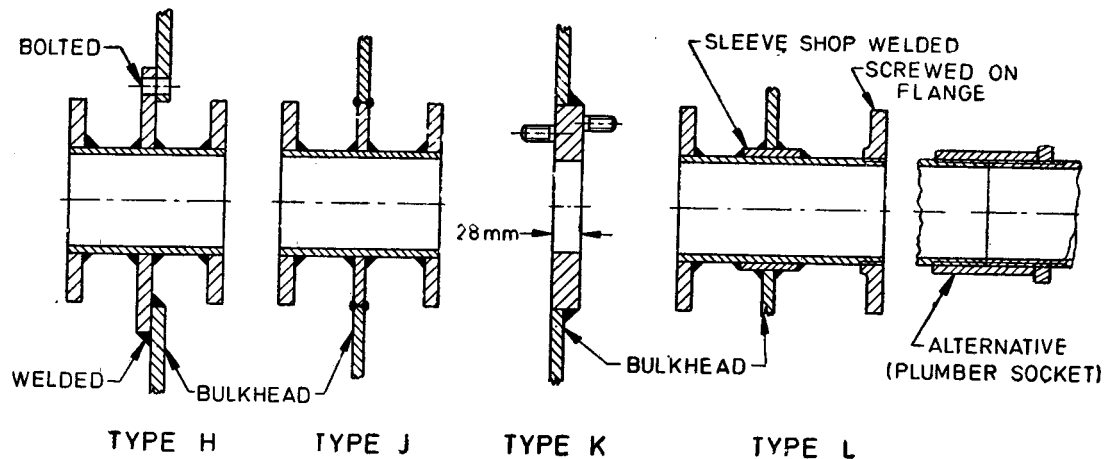
**4.5.2 Sea Strainers** — Sea strainers, where provided, shall be fitted to screen out solids which have passed the shipside weed grids. The strainers shall be capable of stopping solids larger than 10 mm diameter, but in certain cases additional finer filtration may be required. The ratio of clear area through the strainer to area of sea inlet valve or valves shall not be less than 2.5 : 1. The strainer shall be capable of being isolated to enable it to be opened up for inspection and removal of trapped solids. Sea strainer bodies may be of cast or fabricated construction with a securely jointed access cover and with a removable perforated screen or cage.

## 4.6 Protective Coatings for Service

**4.6.1** A protective coating shall be applied to all steel pipework and fabricated components in the finished condition prior to installation. This protection shall normally be hot-dip galvanizing in accordance with IS : 4736-1968\*. The minimum weight of coating shall be 600 g/m<sup>2</sup> for all thicknesses, and shall be measured in accordance with IS : 2633-1972†. Cracking can occur as a result of galvanizing heavily cold-worked pipe. This can be avoided by stress-relieving at 600-650°C prior to galvanizing.

\*Specification for hot-dip zinc coatings on steel tubes.

†Method for testing uniformity of coating on zinc coated articles (*first revision*).



NOTE — For Types H and J, the bulkhead flange may be attached to the bulkhead by lap or butt welds or may be butted by the methods shown in Fig. 10A of IS : 7304 (Part II) - 1974.

FIG. 3 GALVANIZED FABRICATED STEEL BULKHEAD PIECES



**4.6.2** There are many non-metallic protective coatings available but service experience to date is inadequate for recommendations to be made. Any such protective coating shall be subject to agreement between the purchaser and the manufacturer.

## **5. INSTALLATION**

**5.1** The ferrous system shall be installed in accordance with IS : 7304 ( Part I )\*.

## **6. INSPECTION AND TESTING**

**6.1 Component Inspections and Tests Before Installation** — The shop inspection and test of components for ferrous system shall be carried out in accordance with IS : 7304 ( Part I )\*.

**6.2 System Inspection and Tests After Installation** — These shall be carried out in accordance with IS : 7304 ( Part I )\*.

**6.3 Sea Trials** — Sea trials for ferrous system shall be carried out in accordance with IS : 7304 ( Part I )\*.

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\*Code for fabrication, installation and testing of salt water piping system for ship board use: Part I General requirements ( *under preparation* ).

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